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February 1, 2007

**VIA EFS**  
**(Total No. of Pages Transmitted: 12)**

To: Examiner Ngo, C.  
Group Art Unit No. 2193

From: Frederick E. Cooperrider

Facsimile No.: (703) 761-2375 or 76

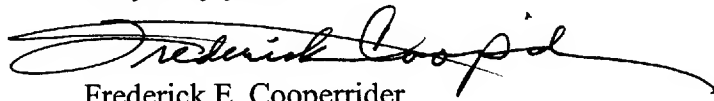
Re: Statement of Substance of Interview  
U.S. Patent Application Serial No. 10/671,888  
Attorney Docket No. YOR920030169US1 (YOR.463)

Examiner Ngo:

Thank you for taking time today for a telephone interview involving the above-identified Application. Enclosed is a Statement of Substance of Interview, which we request be made of record, for this telephone interview.

Thank you in advance for your kind consideration on this case.

Very truly yours,



Frederick E. Cooperrider  
Registration No. 36,769

FEC/fec  
Enclosure: 11 pages

S/N: 10/671,888  
Docket: YOR920030169US1 (YOR.463)

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of

Gustavson, et al.

Serial No.: 10/671,888

Group Art Unit: 2193

Filed: September 29, 2003

Examiner: Ngo, C. D.

For: METHOD AND STRUCTURE FOR PRODUCING HIGH PERFORMANCE LINEAR  
ALGEBRA ROUTINES USING REGISTER BLOCK DATA FORMAT ROUTINES

Honorable Commissioner of Patents  
Alexandria, Virginia 22313-1450

**STATEMENT OF SUBSTANCE OF INTERVIEW**

Sir:

In response to the requirement in 37 C.F.R. §1.2, 37 C.F.R. §1.133, and MPEP §713.04, that Applicants provide a statement of the substance of an interview, Applicants hereby submit the following summary.

Applicants gratefully acknowledge Examiner Ngo for taking time from his busy schedule to conduct a telephone interview on February 1, 2007, for the above-referenced Application. The interview was courteous and professional, and it is believed by Applicants' representative that prosecution has been advanced because of this interview.

Concerning the substance of the interview, co-inventor Gustavson presented a brief summary of the present invention, as described on the attached presentation materials, including a comparison with the cited prior art.

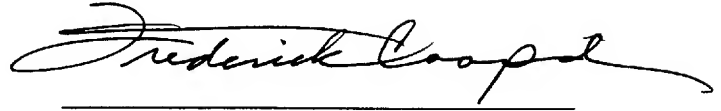
S/N: 10/671,888

Docket: YOR920030169US1 (YOR.463)

The Examiner indicated appreciation for the presentation and agreed to consider its contents in the evaluation of Applicants' next response.

Respectfully submitted,

Date: 2/1/07

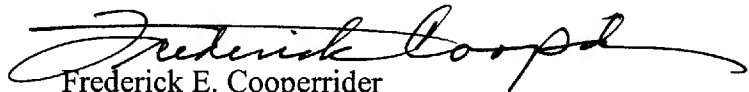


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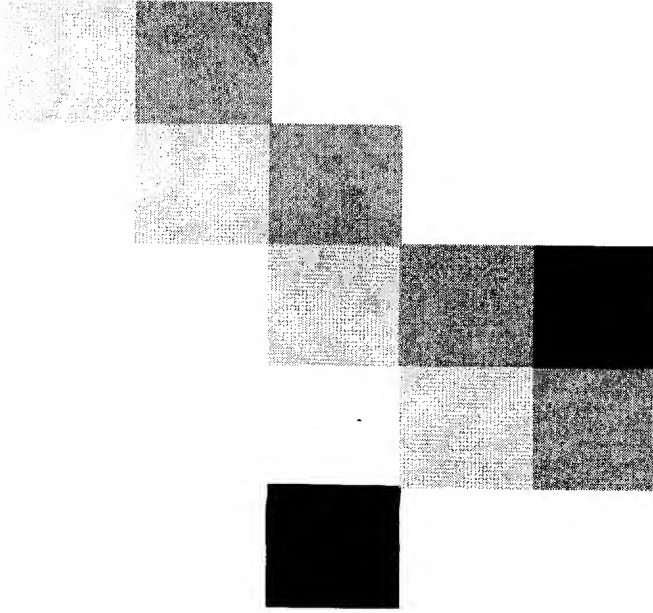
CERTIFICATION OF TRANSMISSION

I certify that I transmitted electronically, via EFS, this Statement of Substance of Interview to Examiner Ngo on February 1, 2007.



Frederick E. Cooperrider  
Reg. No. 36,769

Attachments: Presentation materials (9 pages)



# Patent Application 10/671,888

Fred Gustavson  
IBM Research  
February 1, 2007

# Overview of Talk

- Lao and Patent RBF is an Apples to Oranges Comparison
- Lao is concerned with fast in-place transposition
  - Uses standard matrix data format
- RBF fixes a hardware deficiency via a software change
  - Uses a non standard matrix data format
  - Uses preprocessing step and later a correcting step

# Simple Square Block Format

- Each block is stored as a standard 2D Fortran or C array
  - $SB(la, nb)$  with  $la=nb$
  - store either by row or column
  - row storage gives transpose of a SB
- supported by level 3 BLAS
- maps optimally into the L1 cache

# Union of Register Blocks: RBF

- a simple SB is 2D array of smaller SB's
  - SB is 2D array of sub-matrices of size  $m$  by  $k$
  - both  $m$  and  $k$  divide  $nb$
  - $m$  and  $k$  are platform dependent
- Fixes a BG/L hardware deficiency
- supported by platform dependent BLAS kernels
- maps optimally into L1 and L0 caches

# DGEMM on RBF format

- For 3 SB's A, B, C this is a call to a DGEMM kernel
  - kernels use RBF format
  - sketch of details follows on next slide



# A DGEMM kernel for Register Blocks

- DGEMM kernel consists of executing  $m \times n$  fundamental GEMM building blocks
  - $m \times mb = M$  and  $n \times nb = N$
  - requires  $mb + 2 \times nb$  stride one data streams
- most platforms do NOT support this number of data streams
  - three is the minimum for DGEMM: A, B & C
  - RBF gives a minimum of three streams

# Use of SB and SBP formats

- translate most linear algebra factorization codes verbatim
  - use submatrix partitioning as does Lapack
  - scalar operations become L3 BLAS calls
  - use L3 BLAS on simple SB
- SB give optimal L1 performance
  - Standard 2D arrays do NOT

# Notes on Lao Patent

- does not fix a hardware deficiency
- starts and ends in standard format
- preprocessing does not work for Lao



# Summary of Lao vs. RBF

- RBF fixes a hardware deficiency of many of today's processors via a software fix
  - uses non-standard data formats
  - uses a two step procedure to fix deficiency
- Lao is a software procedure for in-place transposition using standard data formats
- Applies to Oranges comparison